

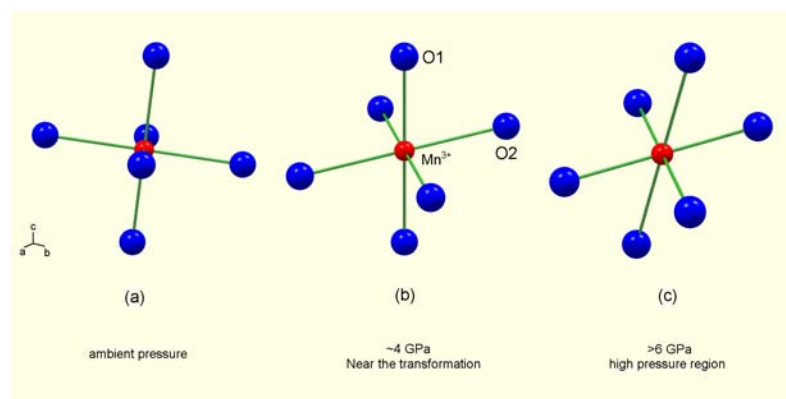
# A Structural Study of Strain Effects in Manganite Films

T. A. Tyson, DMR-0209243

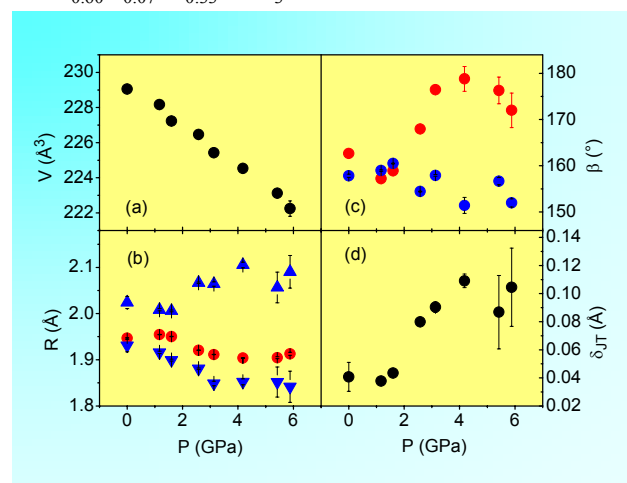
We are conducting research with the goal of providing insight into the intimate coupling of electron spin, electron transport and atomic structure in the manganite system.

This work may lead to the development of more accurate models of systems with strong electron-lattice correlations and the development of film-based magnetoresistive sensors. Detailed measurement of the pressure dependence of the atomic structure in bulk samples showed that a critical pressure is reached at which the magnetic and transport properties are optimized (metal – insulator transition temperature). This pressure near  $\sim 40,000$  atmospheres (4 GPa), is found to be characteristic of a broad range of manganites. Pressure measurements on films of varying thickness are in progress.

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The Jahn-Teller distortion and tilting of the  $\text{MnO}_6$  octahedra under pressure in  $\text{La}_{0.60}\text{Y}_{0.07}\text{Ca}_{0.33}\text{MnO}_3$



Pressure dependence of structure parameters at room temperature. (a) Unit cell volume; (b) Mn-O bond lengths of the "ab-plane" Mn-O2 bonds (up and down solid triangles) and "c-axis" Mn-O1 bond (circles); (c) The "ab-plane" Mn-O2-Mn (blue circles) and "c-axis" Mn-O1-Mn (red circles) bond angles; (d) The coherent Jahn-Teller distortion parameter.

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## Education:

Under this grant two graduate students are conducting multiple length-scale structural and transport measurements of films and comparing the results with bulk high pressure measurements. A post doctoral researcher is involved in detailed LSDA simulations of electron phonon coupling in oxides of this class. The experiments involve extensive use of Brookhaven National Laboratory's National Synchrotron Light Source for x-ray scattering and spectroscopic measurements. In addition, sample preparation and initial characterization is performed at NJIT. Hence both advanced researchers and graduate students are learning new and novel synthesis, measurement and analysis methods.

## Outreach:

A seven-week summer workshop on the preparation and characterization of high temperature superconductors has been taught over the last five Summers with NSF support. Under the direction of the PI, eight to ten Newark area high school students are involved in two 2.5 hours workshops each week learning basic scientific techniques. An additional group composed of two students work in the laboratory each day (eight hours) for the 7 week period conducting more detailed investigations on the same topics. Both groups learn basic chemistry, electronics, solid state physics and computer programming. They prepared YBCO and characterized it by x-ray diffraction, electrical resistivity, Raman spectroscopy and the Meissner effect.



High school students preparing and characterizing YBCO, and presenting results.